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Cinqualbre

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[54] **DEVICE FOR CHEMICAL ANALYSES**

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Related U.S. Application Data

[63] Continuation of Ser. No. 267,167, June 28, 1972, abandoned, which is a continuation of Ser. No. 40,161, May 25, 1970, abandoned.

[30] **Foreign Application Priority Data**

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[51] Int. Cl. **B65b 1/10; G01n 31/22; G01n 33/16**

[58] Field of Search **23/230 R, 230 B, 253 R, 23/259, 292; 141/35, 36, 130, 325**

[56] **References Cited**

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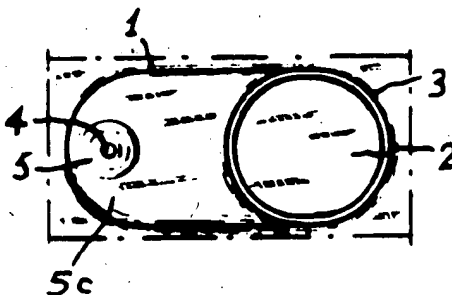
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[57] **ABSTRACT**

A device for chemical analysis, small sized, and essentially constituted by a thin support in which are incorporated receptacles each of which previously receives a dosed quantity of a determined coloured reagent and the product to be analysed is introduced into each receptacle either in solution or suspended in a liquid.

17 Claims, 6 Drawing Figures



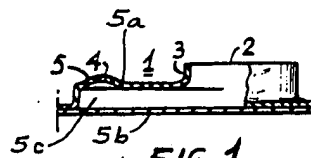


FIG. 1

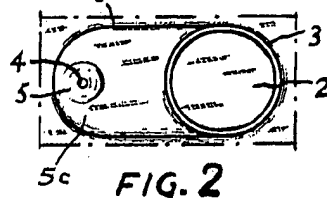


FIG. 2

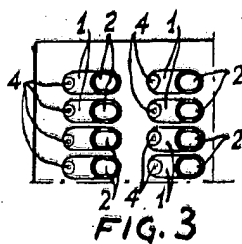


FIG. 3

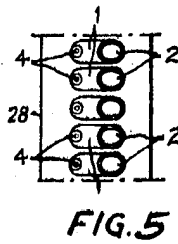


FIG. 5

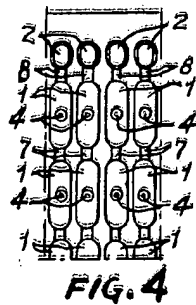


FIG. 4

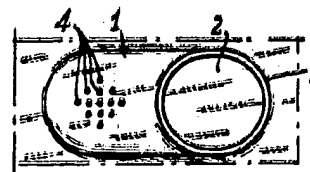


FIG. 6

DEVICE FOR CHEMICAL ANALYSES

This is a continuation of application Ser. No. 267,167, filed June 28, 1972, now abandoned, which is a continuation of application Ser. No. 40,161, filed May 25, 1970, now abandoned.

This invention concerns an improved device for chemical analyses and more particularly; a device for providing a site for the analysis of a substance which is either suspended or dissolved in a liquid. A reagent material is disposed in this site.

There are known a large number of types of installations and implements for performing chemical analyses qualitative and quantitative, by means of coloured reagents. However, the installations and implements presently known are of delicate utilization, require a long time for performing an analysis and are brittle, costly and bulky.

An object of this invention is the elimination of the above disadvantages by means of a device for chemical analyses, easy to use, able to give quickly accurate results, practically unbreakable, cheap and small-sized.

The device for chemical analyses according to one non-limiting and purely exemplary aspect of this invention includes at least a set of receptacles separated each from another and forming one body with a thin support, means for filling said receptacles, means for the escape of the air from said receptacles at the time of the filling of said receptacles each of which has at least a transparent wall portion and each of which previously receives a dosed quantity of a determined coloured reagent.

It is possible to manufacture the analysis device as a unit from two sheets of plastic material shaped and gathered face to face by any appropriate means, at least one sheet being transparent.

It is also possible to provide filling means for each of said receptacles.

Further it is possible to provide air-escape means for each receptacle.

The invention will be described, by way of example only, with reference to the accompanying drawings, in which:

FIGS. 1 and 2 are, respectively, a side elevation and a plan view of an embodiment of an elongated receptacle of an analysis device according to the invention wherein the general shape of the device when viewed from the perspective of FIG. 2 is of a racetrack configuration.

FIGS. 3 to 5 are respective partial plan view of distinct embodiments of the analysis device, and

FIG. 6 is a plan view of an embodiment of a receptacle.

By reference to FIGS. 1 and 2, reference numeral 1 indicates a receptacle of an analysis device. This receptacle 1 comprises a set of flat parallel structure forming walls 5a, 5b with a comparatively narrow clearance between them, which constitute the top and bottom walls of the receptacle. Side walls are provided which meet the said top 5a and bottom 5b walls in generally a perpendicular manner. Thus the cross-section transverse to the length of the elongated receptacle 1 is generally rectangular.

In this embodiment, the top and bottom walls generally are of greater width than the side walls.

The device has filling means for the introduction of the liquid to the interior of the receptacle. These means

comprise an opening 2 in the top wall 5a, disposed adjacent to one end of the receptacle, the opening 2 completely encircled by a skirt or flange 3, which forms a reservoir for the liquid.

There is also an orifice 4 in the top wall 5a to facilitate the release of air from the interior of the receptacle during the filling of the receptacle with the liquid. While this may be located at any location in the top wall, it is preferable to locate this orifice adjacent the end of the receptacle farthest from the filling means.

The orifice 4 may be in the form of a hole through the top wall. However, it is preferable to have a small protuberance 5 adjacent the end of the receptacle and to have the orifice disposed centrally in the protuberance. The protuberance 5 has its concavity facing the interior of the receptacle and is most easily formed and convenient if of generally hemispherical concavity.

The orifice 4 should be of sufficiently small size to prevent the passage of liquid therethrough.

As shown in FIG. 3, the analysis device includes, in the illustrated embodiment, a plurality of rows of receptacles 1.

FIG. 4 shows an embodiment in which the analysis device has a plurality of rows of groups of receptacles 1. Each receptacle 1 of a group communicates with another by a conduit 7, which conduit is of substantially smaller transverse cross-sectional area than that of the receptacles and, at an end of each group, the first receptacle 1 communicates by a conduit 8 with filling means 2 forming a sort of little cup or reservoir open upwardly. Each receptacle 1 has air-escape means 4 formed by a central hole or orifice passing through a swell or protuberance of its own wall. This orifice is preferably disposed centrally in the top wall of the receptacle.

In the embodiments, illustrated in FIGS. 3 and 4 the analysis device has the general shape of a rectangular plate.

As shown in FIG. 5, the analysis device has the general shape of a band 28. On the upper face of this band 28 stand out receptacles 1, regularly distributed on the whole length of the band. Each receptacle 1 has filling means 2 formed by an upper opening bordered by a skirt or flange and air-escaping means 4 formed by a hole passing through a swell or protuberance of its own wall.

The receptacle 1, shown in FIG. 6 has a plurality of air-escaping holes 4 of very reduced passage section.

In all the embodiments above described, it is possible to manufacture the analysis device by forming two sheets of plastic material which are gathered face to face by any appropriate means, for example by welding or sticking. The device is conveniently formed from two thermoplastic sheets, one being flat and the other have a relieved portion molded therein, with the two layers heat sealed about the periphery of each receptacle. It is also possible to use a process of moulding of plastics by injection. In instances in which one or more of the receptacles of this invention are made by adhering sheets of plastic together, it is seen as in FIGS. 1 and 2, that this construction results in the function of an analysis site 5c comprising an upper wall 5a and a lower wall 5b which may be sufficiently close together to provide a relatively narrow clearance therebetween, thereby facilitating the filling of the interior 5c of the receptacle. It is noted that it is possible to provide that the upper wall 5a be transparent, the lower wall 5b

being opaque. This construction inherently permits easy viewing of the mixture of reagent and the substance to be analyzed, within the analysis site 5c in which the mixture and reagent reaction occurs. Additionally, opacity of the lower wall 5b of the analysis site 5c can be used to form a contrasting backdrop of a particular color against which any color change of the reagent is emphasized to the eye.

In the case of the embodiment, shown in FIG. 3, it is possible to provide any desired number of receptacles 1 and of rows of receptacles 1. In the case of the embodiment, illustrated in FIG. 4, it is possible, to provide any desired number of receptacles 1 in each group and any desired number of groups and of rows of groups. Thus, by providing each receptacle of a group with a different reagent, it is possible to simultaneously perform a plurality of tests on the liquid and to simultaneously observe the results of these tests.

In the case of the embodiment illustrated in FIG. 5, the length of the band 28 is defined in relation with the desired number of receptacles 1.

The device for chemical analyses according to the invention is used as follows. The device is placed horizontally and the openings and reservoirs of the filling means 2, are directed upwardly. The product to be analysed which is either liquid or suspended into a liquid, is introduced by means of a pipette for example into the reservoirs of the filling means. At this time, because the escape of the air through the orifices 4 and aided by the relatively close spacing of one pair of oppositely disposed walls, the interiors of the receptacles of the device become full of product to be analyzed which reacts with the coloured reagent contained within the interior of each receptacle. The color produced within each receptacle is then sensed.

When utilizing an analysis device comprising a plurality of receptacles, in serial communication the liquid is introduced into the filling means. The liquid then flows through the receptacles and conduits to entirely fill all receptacles in the series. The reagents used in the analysis device are chosen and treated so that, namely in the case of the embodiment shown in FIG. 4, the diffusion from a receptacle to another in a same group is negligible. Moreover, the volumes of the receptacles are always full of the product to be analysed whereby a stationary state is obtained.

The coloured reactions occurring within the receptacles are observable and interpretable in direct vision. It is also possible to use a photometric method. Further it is possible to record the reaction in colour photography. Moreover it is provided to work the obtained coloured reactions by means of a reading device connected to a computer.

When the reagent of each set of groups of receptacles 1 (FIG. 4) is the same, the dosed quantity of this reagent is variable from a receptacle to another in the same group; a receptacle receiving a normal dose, some receptacles a higher dose and others a lower dose with respect to the normal dose. It is possible to provide the normal dose in the central receptacle of each group. When each group has five receptacles 1, it is advantageous that the quantities of reagent in the receptacles disposed at one side of the central receptacle are decreasing submultiples of the normal dose and that the quantities of reagent in the receptacles disposed at the other side of the central receptacles are increasing multiples of this normal dose. Thus, it is possible to ob-

tain a very fine appreciation of the results of the reactions.

In the case of the embodiments shown in FIGS. 3, 4 and 5, which involve a plurality of receptacles fixedly mounted with respect to each other on a single sheet, means can be provided to introduce the substance to be analyzed into each of the receptacles. Mechanical means can be associated with the plurality of receptacles to successively move the skirt around the filling reservoir of each receptacle into proximity with the filling or introducing device, such that each of the receptacles can be automatically filled. Likewise, in connection with the step of observing the changes in condition of the reagent, where this is to be done by automatic sensing means, such as by photometric devices, means can be provided to successively move the analysis chamber portion of each receptacle into operative proximity with the sensing device, so that the test results observable in a plurality of the receptacles can be automatically and quickly determined.

When a wall of the receptacles is opaque for facilitating the reading of the coloured reaction by increasing of the optical contrasts, it is possible, according to the reactions anticipated, to choose a particular colour for this opaque wall, which may either optically contrast with or be similar to the anticipated color produced in the analysis site, this colour being different from a device to another. Further, it is possible to provide for each row of receptacles or of groups of receptacles, in a same analysis device, opaque bands of distinct colours.

I claim:

1. A device for providing a site for the analysis of a substance present in liquid when the liquid is mixed with a reagent disposed in the site, the device comprising:

structure forming walls of an elongated receptacle having a cross-section transverse to the length thereof which is substantially rectangular, the walls of the receptacle including pairs of oppositely disposed walls, with the walls of the pairs having different widths, at least one wall of the pair having a greater width being substantially transparent to expose the liquid within the receptacle, one of the walls having an opening adjacent one end portion of the receptacle for receiving liquid into the interior of the receptacle, a flange completely encircling the opening and extending outwardly from the wall adjacent to the opening to form a reservoir at the opening, to facilitate the delivery of liquid to be received by the opening, and at least one orifice of predetermined size disposed therein displaced from the opening along the length of the receptacle and adjacent the end portion of the receptacle opposite to the one end portion thereof, for releasing air from the interior of the receptacle when liquid is received therein, the predetermined size of the orifice being sufficiently small to prevent the release of liquid therethrough, at least some of the walls of the receptacle being spaced apart from one another by a comparatively narrow clearance; whereby the filling of the interior of the receptacle with liquid between the opening and the orifice is facilitated by the narrow clearance of the receptacle and the release of air from the interior of the receptacle by the orifice.

2. The device of claim 1, further comprising a protuberance extending outwardly with respect to the wall of said receptacle in which the orifice is disposed, the orifice extending through the central portion of the protuberance.

3. The device of claim 1, in which the cross-section of the receptacle in a plane parallel to the walls of the pair having a greater width has the form of a racetrack configuration.

4. The device of claim 1 in which the structure comprises:

two layers of thermoplastic material, at least one of the layers having a relieved portion therein for forming the transparent wall of the receptacle, the other of the layers forming the remainder of the receptacle, the layers being sealed together about the periphery of the receptacle.

5. The device of claim 1, in which a pair of oppositely disposed walls of greater width of said receptacle are flattened into two planes which are parallel to each other and extend in the direction of elongation of the receptacle, the flattened walls being separated by a comparatively narrow clearance which is a minor fraction of the width of the receptacle taken in a direction parallel to the two planes and perpendicular to the direction of elongation of the receptacle.

6. The device of claim 1 in which at least a portion of the walls of the receptacle viewable through the transparent portion is opaque.

7. The device of claim 6, in which the opaque wall is a color which optically contrasts with a predetermined color, whereby the choice of color of the opaque wall may be based on the anticipated color of the mixture of the reagent and predetermined substance in the liquid to facilitate reading of the analysis results.

8. The device of claim 1 and further comprising a dosed quantity of reagent disposed in the interior of the receptacle prior to being mixed with the predetermined substance present in the liquid, the reagent when mixed in the receptacle with the predetermined substance present in the liquid causing the resulting mixture within the receptacle to have a predetermined color, the occurrence of the predetermined color providing information relating to the analysis of the substance.

9. The device of claim 8, in which at least a portion of the walls of the receptacle is transparent, and at least one wall of the receptacle viewable through the transparent portion bears an opaque band of color, the color of the band being a color which optically contrasts with the predetermined color.

10. A device for providing a site for the analysis of a substance present in liquid when the liquid is mixed with a reagent disposed in the site, the device comprising:

structure forming walls of an elongated receptacle having a cross-section transverse to the length thereof which is substantially rectangular, the walls of the receptacle including pairs of oppositely disposed walls, with the walls of the pairs having different widths, at least one wall of the pair having a greater width being substantially transparent to expose the liquid within the receptacle; one of the walls having an opening for receiving liquid into the interior of the receptacle; one of the walls having at least one orifice of predetermined size disposed therein displaced from the opening along the length of the receptacle for releasing air from the

interior of the receptacle when liquid is received therein, the predetermined size of the orifice being sufficiently small to prevent the release of liquid therethrough, at least some of the walls of the receptacle being spaced apart from one another by a comparatively narrow clearance, whereby the filling of the interior of the receptacle with liquid between the opening and the orifice is facilitated by the narrow clearance of the receptacle and the release of air from the interior of the receptacle by the orifice, and at least one additional receptacle substantially corresponding to the receptacle, the opening of the additional receptacle being connected to the interior of the receptacle by means of a conduit, whereby upon adding of liquid to the receptacle, the liquid passes into and completely fills both the receptacle and the additional receptacle permitting accurate analysis of the condition of the liquid and reagent in each of the receptacle and additional receptacles.

11. The device of claim 10, in which the transverse cross-sectional area of the conduit is less than the transverse cross-sectional area of the receptacle.

12. The device of claim 10, in which the orifice of the additional receptacle is disposed substantially equidistant between the ends of the elongated receptacle.

13. The device of claim 10, in which a portion of the walls of each of the receptacle and additional receptacles which are viewable through the transparent walls are opaque, each of the opaque portions being of a different color.

14. The device of claim 10, and further comprising a dosed quantity of reagent within the interior of each of the receptacle and the additional receptacle prior to being mixed with the predetermined substance present in liquid, the dosed quantity of reagent in the receptacle and the additional receptacle being different, whereby the receptacle and the additional receptacle, when each is filled with the liquid, enable varying concentrations of reagent in the liquid to be compared.

15. The device of claim 10, and further comprising dosed quantities of different reagents in each of the receptacle and additional receptacle, whereby the reaction of various reagents to the substance in the liquid can be observed simultaneously when the receptacle and the additional receptacle are filled with the liquid, and a plurality of tests can thereby be performed on the liquid.

16. A device of claim 10, further comprising:

a. a plurality of the additional receptacles corresponding to the receptacle and connected in a series with the receptacle by means of conduits, each conduit extending between the interior of the one of the receptacle and additional receptacles immediately preceding the conduit in the series and the openings of the one of the receptacle and additional receptacle immediately subsequent to the conduit in the series; and

b. a dosed quantity of the same reagent dispersed in each of the receptacle and additional receptacle, the amount of the dosed quantity being relatively graduated in increasing amount in one direction of progression along the series;

whereby, when the receptacle and additional receptacles are filled with the liquid, the concentration of reagent varies from one receptacle and additional receptacle to another in the series, thus enabling a fine appre-

ciation of the test results obtained among different graduated concentrations of reagents in the liquid.

17. The device of claim 16, in which the additional receptacles are four in number, the central one of the five additional receptacles and receptacle having a normal dosed quantity of reagent, the two of the additional

receptacles and receptacle on one side of the central one having dosed quantities larger than normal, the two of the receptacle and additional receptacles on the other side of the central one having dosed quantities which are smaller than the normal dosed quantity.

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